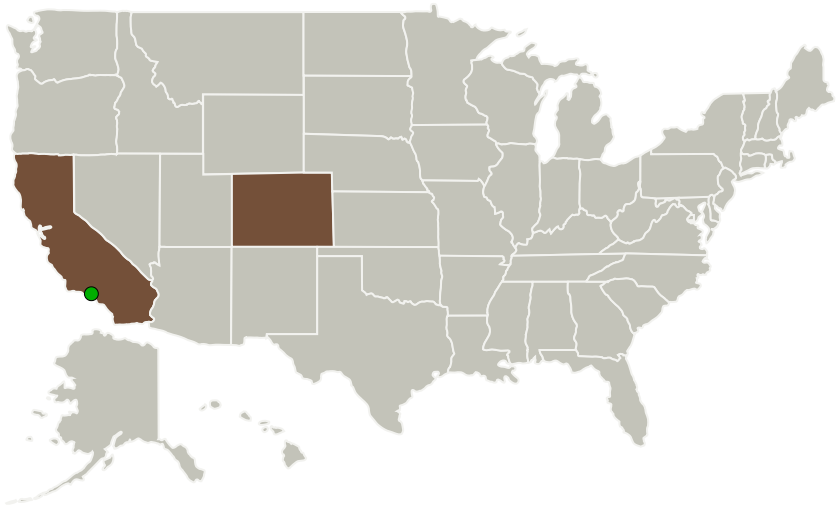
# Thermopile Area Array Readout, Phase I

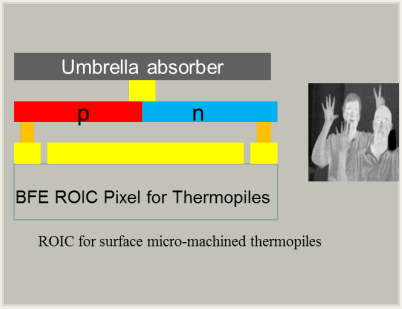
Completed Technology Project (2013 - 2013)

## Project Introduction

NASA/JPL thermopile detector linear arrays, wire bonded to Black Forest Engineering (BFE) CMOS readout integrated circuits (ROICs), have been utilized in NASA missions such as the Mars Climate Sounder and the Diviner Lunar Radiometer Experiment. Linear array thermopile detectors are fabricated by bulk micro-machining. Surface micro-machined thermopiles are desirable for area array thermopiles because the architecture provides both high detector fill factor and circuit fill factor in the pixel. The Phase I effort designs an area array ROIC compatible with surface micro-machined thermopile detectors to meet requirements of future NASA thermal instruments requiring D-Star > 4 x 109 Jones. Radiation hard-by-design will be utilized with 180 nm CMOS for low 1/f noise readout, operating temp 77-300 K, radiation hardness and noise immunity with on-ROIC ADC. Various pixel pitches and binning methods will be investigated to cover a desired wavelength detection range of 20µm – 100 µm. The Phase I ROIC array design, in a 128x128 or larger format, will be fabricated on Phase II.

## Primary U.S. Work Locations and Key Partners



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| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| Black Forest Engineering, LLC | Lead Organization | Industry | Colorado Springs, Colorado |
| Jet Propulsion Laboratory(JPL) | Supporting Organization | NASA Center | Pasadena, California |

| Primary U.S. Work Locations | |
|---|---|
| California | Colorado |

## Project Transitions

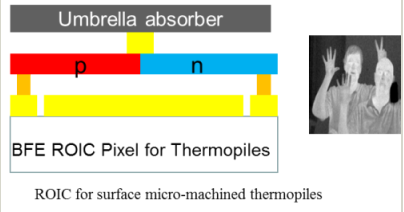
**May 2013:** Project Start

**November 2013:** Closed out

**Closeout Documentation:**

- Final Summary Chart*(https://techport.nasa.gov/file/139386)*

## Images




**Project Image**
Thermopile Area Array Readout
*(https://techport.nasa.gov/image/135957)*

## Organizational Responsibility

**Responsible Mission Directorate:**
Space Technology Mission Directorate (STMD)

**Lead Organization:**
Black Forest Engineering, LLC

**Responsible Program:**
Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**
Jason L Kessler

**Program Manager:**
Carlos Torrez

**Principal Investigator:**
Stephen Gaalema

**Co-Investigator:**
Stephen Gaalema

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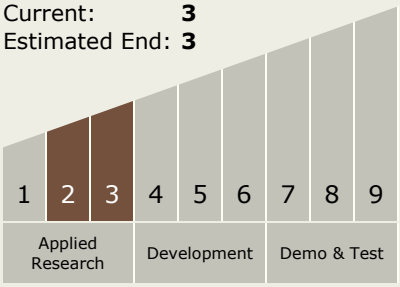
## Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**




## Technology Areas

**Primary:**

- TX02 Flight Computing and Avionics
  - TX02.1 Avionics Component Technologies
    - TX02.1.6 Radiation Hardened ASIC Technologies

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System